DEPARTMENT OF MECHANICAL ENGINEERING
WILLIAM MAXWELL REED SEMINAR SERIES

"Attitude Control on SO(3) with Piecewise Sinusoids"

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Abstract: In this talk we address rigid body attitude control with piecewise sinusoidal signals. We consider rigid-body attitude kinematics on SO(3) with a class of sinusoidal inputs. We present a new closed-form solution of the rotation matrix kinematics. The solution is analyzed and used to prove controllability. We then present kinematic-level orientation-feedback controllers for set point tracking and command following.

Next, we extend the sinusoidal kinematic-level control to the dynamic level. As a representative dynamic system, we consider a CubeSat with vibrating momentum actuators that are driven by small (ϵ) amplitude piecewise sinusoidal internal torques. We assume there is no external forcing and the system conserves zero angular momentum. A second-order approximation of the CubeSat rotational motion on SO(3) is derived and used to derive a set point tracking controller that yields order $O(\epsilon^2)$closed-loop error. Numerical simulations are presented to demonstrate the performance of the controls.

Furthermore, we investigate the feasibility of the piecewise sinusoidal control techniques using an experimental CubeSat system. Experiment results of yaw motions control are presented.

Bio: Shaoqian Wang received the B. S. degree in Mechanical Engineering from Harbin Institute of Technology (China) in 2011, the M. S. degree in Electrical Engineering from the University of Kentucky in 2016, and the Ph. D. degree in Mechanical Engineering from the University of Kentucky in 2018. He has seven publications on control system design and system identification. His current research interest is in the control of mechanical systems and robotics.

Date: Friday, September 14
Time: 3PM
Place: CB 114
Contact: Dr. Alexandre Martin 257-4462

Meet the speaker and have refreshments
Attendance open to all interested persons

College of Engineering

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